Investigation of a Northern Gulf of Mexico brain coral, *Diploria strigosa*, for climate reconstructions

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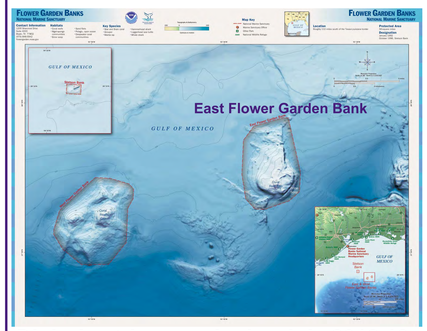
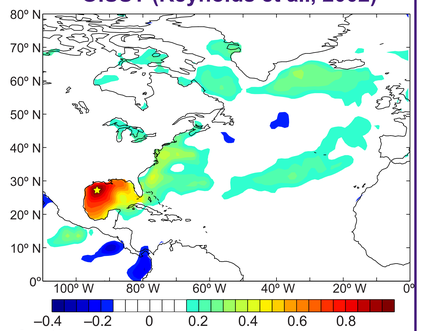
Abstract

Paleoclimatologists have produced sea-surface temperature (SST) reconstructions from coral geochemistry by sampling fast growing brain corals commonly found in the Atlantic Ocean. Many researchers avoid deeper coral reefs, >10-m water depth, because the geochemistry of these corals may not reflect SST due to water stratification and to avoid possible kinetic effects due to reduced coral growth with increasing water depth. Flower Garden Banks is the northernmost coral reef in the Gulf of Mexico with the top of the reef at 18 m from the surface. In 1979, the U.S. Geological Survey recovered a core from a *Diploria strigosa* colony in the East Flower Garden Bank (27°54'N, 93°35'W) from a depth of ~21 m. Measurements of the x-radiographs reveal an average linear growth rate of 0.51 cm year^{-1} (±1.10, 1σ; n = 38). We analyzed approximately monthly samples (0.03 cm sample^{-1}) extracted along the growth axis for Sr/Ca and $\delta^{18}O$. These geochemical proxies for temperature reveal seasonal cycles; however, the section from 1968–1970 contains a 1.16% shift in the mean Sr/Ca with higher Sr/Ca values present only in the summer samples, resulting in a reduced seasonal cycle. Shifts in coral geochemistry have been noted in other studies with the source of the shifts attributed to diagenesis, sampling artifacts, or growth effects. Our analysis of scanning electron microscope images did not find indications of diagenesis. To test if our sampling rate biased our results, we sampled at a higher resolution (0.01 cm sample^{-1}) and found similar results for Sr/Ca. The anomalous section coincides with a 39% reduction in linear extension rates, leaving a growth effect as the remaining cause. This interval is not the coldest; the interval from 9–12 cm is colder with ≥ average extension rates. This interval coincides a negative Pacific/North American Pattern (PNA). We conclude that corals from this deeper reef show promise for paleoclimate studies; however, further studies are needed.

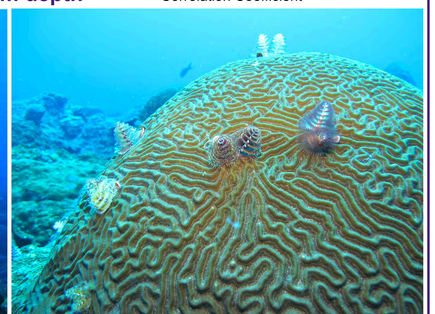
1.Location



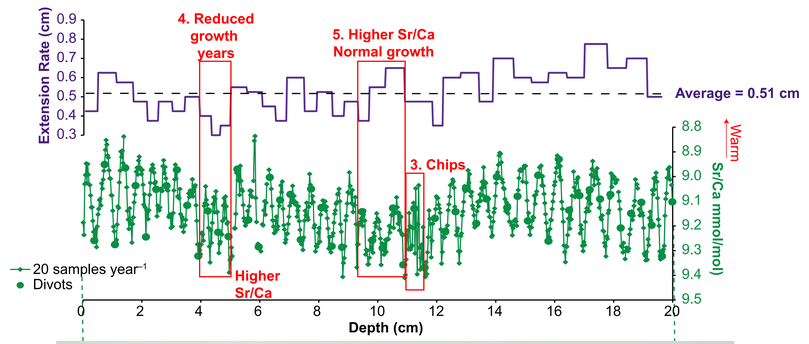
SST correlation map for EFB with OISST (Reynolds et al., 2002)

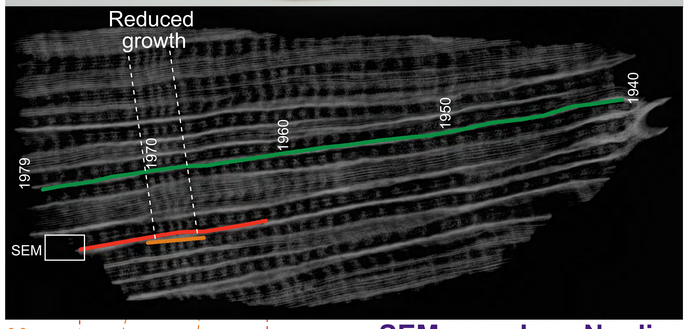


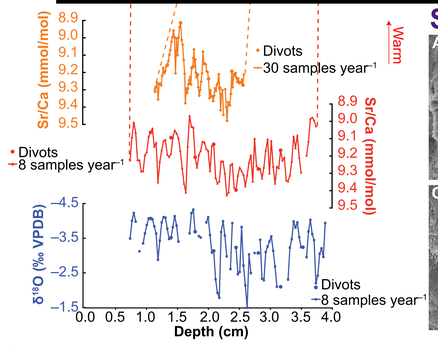
***Diploria strigosa* colonies July 2012 18 m depth**



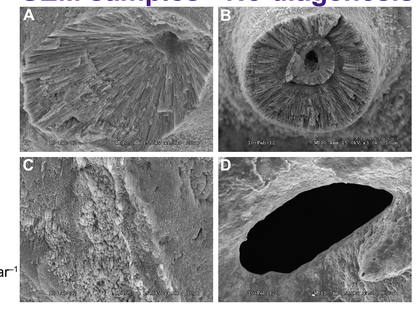
2. Coral Geochemistry and Growth Rates





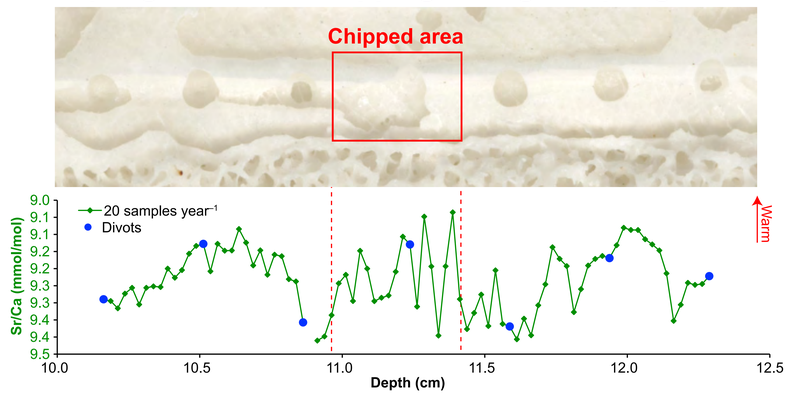


SEM samples - No diagenesis



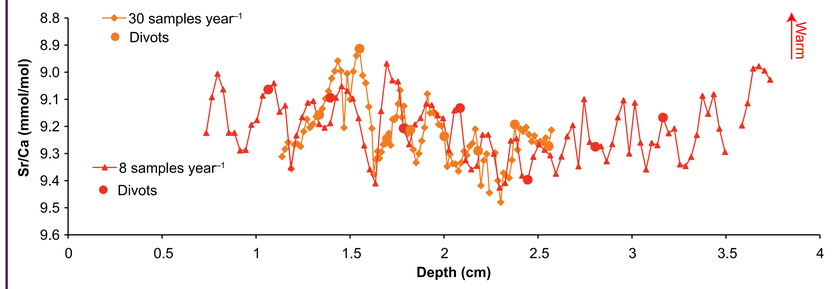
Reduced growth interval is not diagenesis, or sampling artifacts.

3.Sampling Artifacts - Chipping during sampling



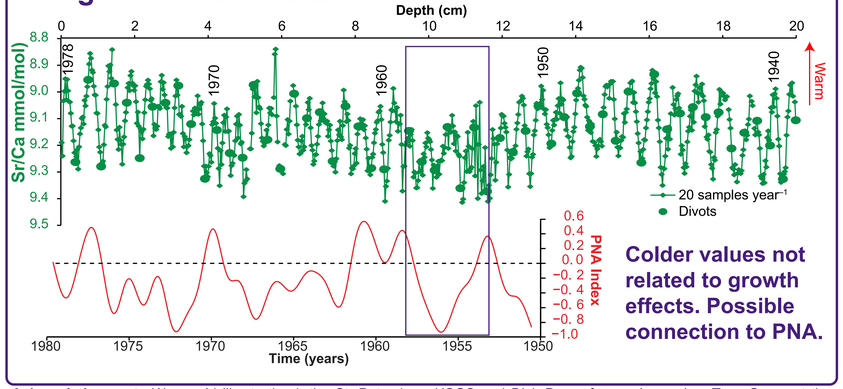
Annual cycles in Sr/Ca determinations is lost in chipped interval.

4. SamplingArtifacts - Sampling Resolution



Higher resolution sampling produced the same higher Sr/Ca values (i.e., colder). We assume this is a growth related effect.

5. Higher Sr/Ca but ≥ Extension Rates



Colder values not related to growth effects. Possible connection to PNA.

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